

## AMENDMENT TO THE CLAIMS

SUMMARY LISTING OF CLAIMS
Claim 1 (canceled)
Claim 2 (currently amended): Test coupon composed of material other than tested structural member and having ligaments of unequal length.
Claim 3 (canceled)
Claim 4 (currently amended): The test coupon in Claim 2 with ligaments of equal length.
Claim 5 (currently amended): Cut-out portions in test-coupon defined by two or more centrally aligned adjoining rectangles.
Claim 6 (original)
Claim 7 (currently amended): Ligaments in test-coupon made of different materials with different elastic moduli.
Claim 8 (currently amended): The test-coupon in Claim 7 composed of materials other than that composing structural member being tested.
Claims 9-16 (original)
Claim 17 (currently amended): Method for determining remaining useful fatigue life of a structural member.
Claim 18 (currently amended): The test coupon in Claim 17 with ligaments of equal length.
Claim 19 (canceled)
Claim 20 (new): Cut-out portions of test-coupon in Claim 17 defined by two or more centrally aligned adjoining rectangles.
Claim 21 (new): Method of making original measurements of fatigue strength and fatigue damage of a structural member.
Claim 22 (new): The test coupon in Claim 21 with ligaments of equal length.

**CLAIMS (continued)**

In response to the Examiner's comments in paragraph 3, the following amended Claim 5 is submitted. Please see the Applicant's remarks below.

Claim 5. (currently amended) An apparatus for measuring the fatigue life of a structural member of known composition, said apparatus comprising:

- a. a flat test-coupon uniformly cast and composed of any material mountable on said structural member,
- b. said test-coupon having at least two cut-out portions of different area which define at least two parallel ligaments of different lengths,
- c. said cut-out portions defining said ligaments having a shape described by at least two centrally aligned adjoining rectangles of different surface area, said centrally aligned adjoining rectangles having rounded corners described by ninety degree arcs joining any two adjacent sides and positioned so that said centrally aligned adjoining rectangles become progressively smaller in surface area, and
- d. said ligaments having a shape so as to effect failure due to fatigue of said ligaments at lower percentages of fatigue life of said structural member and prior to failure of said structural member due to fatigue when said ligament and said structural member are subjected to substantially similar stress conditions and history.

The marked-up version of this (currently amended) Claim 5 appears on the following page.

The original version of Claim 6 is presented pursuant to 37 CFR 1.121 (c) (3).

Claim 6 (original). The apparatus according to Claim 5 wherein said test coupon is composed of a material other than that composing said structural member.

**CLAIMS (continued)**

Pursuant to 37 CFR § 1.121 (c)(1)(ii), Applicant hereby submits the following marked-up version of Claim 5 to show the requested changes:

Claim 5. (currently amended) [The] An apparatus [according to Claim 1 wherein] for measuring the fatigue life of a structural member of known composition, said apparatus comprising:

- a. a flat test-coupon uniformly cast and composed of any material mountable on said structural member,
- b. said test-coupon having at least two cut-out portions of different area which define at least two parallel ligaments of different lengths,
- c. said cut-out portions defin[e]ing said ligaments having a shape described by at least two centrally aligned adjoining rectangles of different surface area, said centrally aligned adjoining rectangles having rounded corners described by ninety degree arcs joining any two adjacent sides and positioned so that said centrally aligned adjoining rectangles become progressively smaller in surface area, and
- d. said ligaments having a shape so as to effect failure due to fatigue of said ligaments at lower percentages of fatigue life of said structural member and prior to failure of said structural member due to fatigue when said ligament and said structural member are subjected to substantially similar stress conditions and history.

In response to the Examiner's comments in paragraphs 4 and 5a, please cancel Claim 1.

**CLAIMS (continued)**

In response to the Examiner's comments in paragraphs 4 and 5b, the following amended Claim 7 is submitted. Please see the Applicant's remarks below.

Claim 7. (currently amended) An apparatus for measuring the fatigue life of a structural member of known composition, said apparatus comprising:

- a. a flat test-coupon composed of two or more materials mountable on said structural member,
- b. said test-coupon having at least two cut-out portions of equal area which define at least two parallel ligaments of equal length and cross-sectional area,
- c. said ligaments being uniformly cast and composed of different materials with different elastic moduli, and
- d. said ligaments having a shape so as to effect failure due to fatigue of said ligaments at lower percentages of fatigue life of said structural member and prior to failure of said structural member due to fatigue when said ligament and said structural member are subjected to substantially similar stress conditions and history.

The marked-up version of this (currently amended) claim 7 appears on the following page.

~

**CLAIMS (continued)**

Pursuant to 37 CFR § 1.121 (c)(1)(ii), Applicant hereby submits the following marked-up version of (currently amended) Claim 7 to show the requested changes:

Claim 7 (currently amended). [The apparatus according to Claim 1 wherein said test-coupon has at least two cut out portions of equal cross-sectional area and which define at least two ligaments of the same length and the same shape with different elastic moduli.] An apparatus for measuring the fatigue life of a structural member of known composition, said apparatus comprising:

- a. a flat test-coupon composed of two or more materials mountable on said structural member,
- b. said test-coupon having at least two cut-out portions of equal area which define at least two parallel ligaments of equal length and cross-sectional area,
- c. said ligaments being uniformly cast and composed of different materials with different elastic moduli, and
- d. said ligaments having a shape so as to effect failure due to fatigue of said ligaments at lower percentages of fatigue life of said structural member and prior to failure of said structural member due to fatigue when said ligament and said structural member are subjected to substantially similar stress conditions and history.

**CLAIMS (continued)**

In response to the Examiner's comments in paragraphs 6 and 7a, the following amended Claim 2 is submitted. Please see the Applicant's remarks below.

Claim 2 (currently amended). An apparatus for measuring the fatigue life of a structural member of known composition, said apparatus comprising:

- a. a flat test-coupon uniformly cast and composed of a material other than that composing said structural member and mountable on said structural member,
- b. said test-coupon having at least two cut-out portions of different area which define at least two parallel ligaments of different lengths, and
- c. said ligaments having a shape so as to effect failure due to fatigue of said ligaments at lower percentages of fatigue life of said structural member and prior to failure of said structural member due to fatigue when said ligament and said structural member are subjected to substantially similar stress conditions and history.

The marked up version of this (currently amended) Claim 2 appears on the following page.

**CLAIMS (continued)**

Pursuant to 37 CFR § 1.121 (c)(1)(ii), Applicant hereby submits the following marked-up version of Claim 2(currently amended) to show the requested changes:

Claim 2 (currently amended). [The] An apparatus [according to Claim 1 wherein said test coupon is composed of a material other than that composing said structural member] for measuring the fatigue life of a structural member of known composition, said apparatus comprising:

- a. a flat test-coupon uniformly cast and composed of a material other than that composing said structural member and mountable on said structural member,
- b. said test-coupon having at least two cut-out portions of different area which define at least two parallel ligaments of different lengths, and
- c. said ligaments having a shape so as to effect failure due to fatigue of said ligaments at lower percentages of fatigue life of said structural member and prior to failure of said structural member due to fatigue when said ligament and said structural member are subjected to substantially similar stress conditions and history.

**CLAIMS (continued)**

In further response to the Examiner's comments in paragraphs 6 and 7a, the following amended Claim 4 is submitted. Please see Applicant's remarks below.

Claim 4 (currently amended). The apparatus according to Claim 2 wherein said cut-out portions are rectangular in shape and having rounded corners described by ninety degree arcs joining any two adjacent sides such that said ligaments are all of equal length and width.

The marked-up version of (currently amended) Claim 4 appears on the following page.



**CLAIMS (continued)**

Pursuant to 37 CFR § 1.121 (c)(1)(ii), Applicant hereby submits the following marked-up version of Claim 4 (currently amended) to show the requested changes:

Claim 4 (currently amended). The apparatus according to Claim [3] 2 wherein said [test coupon is composed of material other than that composing said structural member] cut-out portions are rectangular in shape and having rounded corners described by ninety degree arcs joining any two adjacent sides such that said ligaments are all of equal length and width.

**CLAIMS (continued)**

In further response to the Examiner's comments in paragraphs 6 and 7a, the following amended Claim 8 is submitted. Please see Applicant's remarks below.

Claim 8 (currently amended). The apparatus according to Claim 7 wherein said test-coupon is composed of materials other than that composing said structural member.

The marked-up version of (currently amended) Claim 8 appears on the following page.

**CLAIMS (continued)**

Pursuant to 37 CFR § 1.121 (c)(1)(ii), Applicant hereby submits the following marked-up version of (currently amended) Claim 8 to show the requested changes:

Claim 8 (currently amended). The apparatus according to Claim 7 wherein said test-coupon is composed of [a] materials other than that composing said structural member.

**CLAIMS (continued)**

In response to the Examiner's comments in paragraphs 6 and 7b, please cancel Claim 3.

In response to the Examiner's comments in paragraphs 6 and 8a, Applicant hereby submits (currently amended) Claims 17 and 18 and (new) Claim 20. Please see Applicant's remarks below.

Claim 17 (currently amended). A method for determining the remaining useful fatigue life of a structural member of known composition with known fatigue loading history comprising the steps of:

- a. providing a test-coupon uniformly cast and composed of the same material as that comprising said structural member, said test-coupon having at least two cut out portions of different area which define at least two parallel ligaments of different lengths,
- b. subjecting said test-coupon to repetitive stress loading of a constant displacement until all of said ligaments in said test-coupon fail,
- c. monitoring said test-coupon to determine how many loading cycles are necessary to cause failure in each of said ligaments, and
- d. using number of loading cycles necessary to cause failure in each of said ligaments to determine fatigue strength of each of said ligaments and to predict remaining useful service life of said structural member on the basis of an S-N curve depicting stress loading characteristics of material from which said structural member is composed.

The marked-up version of this (currently amended) Claim 17 appears on the following page.

**CLAIMS (continued)**

Pursuant to 37 CFR § 1.121 (c)(1)(ii), Applicant hereby submits the following marked-up version of Claim 17 (currently amended) to show the requested changes:

Claim 17(currently amended). A method for determining the remaining useful [measuring] fatigue life [strength and fatigue damage] of a structural member of known composition with known fatigue loading history comprising the steps of:

- a. providing a test-coupon [having known fatigue characteristics and configured so as to experience material failure due to fatigue prior to] uniformly cast and composed of the same material as said structural member, said test-coupon having at least two cut out portions of different area which define at least two parallel ligaments of different lengths,
- [b.] [subjecting said test-coupon to repetitive stress loading so that said test-coupon and said structural member have a substantially similar stress history,]
- [c.] rigidly attaching said test-coupon upon said structural member so that said test-coupon experiences the same stress loading as said structural member,]
- [d]b. subjecting said test-coupon [and said structural member] to repetitive stress loading of a constant displacement until all of said ligaments fail,
- [e].c monitoring said test-coupon to determine how many loading cycles are necessary to cause failure in each of said ligaments, and
- [f]d. using number of loading cycles necessary to cause failure in each of said ligaments for fatigue strength of each of said ligaments and to predict remaining useful service life of said structural member on the basis of an S-N curve depicting stress loading characteristics of material from which said structural member is composed.

**CLAIMS (continued)**

In response to the Examiner's comments in paragraphs 6 and 8b, Applicant hereby submits (currently amended) Claim 18. Please see the Applicant's remarks below.

Claim 18 (currently amended). The method according to Claim 17 wherein said cut-out portions are rectangular in shape having rounded corners described by ninety degree arcs joining any two adjacent sides such that said ligaments are all of equal length and width.

The marked-up version of this (currently amended) Claim 18 appears on the following page.

**CLAIMS (continued)**

Pursuant to 37 CFR § 1.121 (c)(1)(ii), Applicant hereby submits the following marked-up version of Claim 18 (currently amended) to show the requested changes:

Claim 18 (currently amended). The method according to Claim 17 wherein said [test-coupon is composed of a material other than that comprising said structural member] said cut-out portions are rectangular in shape having rounded corners described by ninety degree arcs joining any two adjacent sides such that said ligaments are all of equal length and width.

**CLAIMS (continued)**

Claim 20 (new). The method according to Claim 17 wherein said cut-out portions defining said ligaments have a shape described by at least two centrally aligned adjoining rectangles of different surface area, said centrally aligned adjoining rectangles having rounded corners described by ninety degree arcs joining any two adjacent sides and positioned so that said centrally aligned adjoining rectangles become progressively smaller in surface area.

In response to the Examiner's comments in paragraphs 6 and 8c, please cancel Claim 19.



**CLAIMS (continued)**

In further response to the Examiner's comments in paragraphs 6 and 8c, Applicant hereby submits (new) Claims 21 and 22. Please see the Applicant's remarks below.

Claim 21 (new). A method for making original measurements of fatigue strength and fatigue damage of a structural member of known or unknown composition comprising the steps of:

- a. providing a test-coupon uniformly cast and composed of material identical to that comprising said structural member said material having unknown fatigue characteristics, said test-coupon having at least two cut out portions of different area which define at least two parallel ligaments of different lengths and configured so as to experience material failure due to fatigue prior to said structural member,
- b. subjecting said test-coupon to repetitive stress loading of a constant displacement until all of said ligaments in said test-coupon fail,
- c. monitoring said test-coupon to determine how many loading cycles are necessary to cause failure in each of said ligaments,
- d. using number of loading cycles necessary to cause failure in each of said ligaments to determine fatigue strength of each of said ligaments,
- e. recording said number of loading cycles necessary to cause failure in each of said ligaments and plotting said numbers on the "N" axis of said material's blank S-N curves,
- f. plotting said material's fatigue strength as the intersection of a perpendicular line drawn from said plotted points on said material's "N" axis and a perpendicular line drawn on said material's "S" axis and originating at a point corresponding the displacement of stress loading, and
- g. repeating steps a through h for differing values of stress loading.

**CLAIMS (continued)**

Claim 22 (new). The method according to Claim 21 wherein said cut-out portions are rectangular in shape having rounded corners described by ninety degree arcs joining any two adjacent sides such that said ligaments are all of equal length and width.

In response to the Examiner's comments in paragraph 9, (original) Claims 9-16 are presented in clean version pursuant to 37 CFR § 1.121 (c)(3).

Claim 9 (original). An apparatus for multidirectional measurement of fatigue life of a structural member of known composition, said apparatus comprising:

- a. a flat test-coupon uniformly cast and composed of any material mountable on said structural member,
- b. said test-coupon having at least two groupings of at least two cut-out portions of different area which define at least two parallel ligaments of different lengths,
- c. said ligaments having a shape so as to effect failure due to fatigue of said ligaments at lower percentages of fatigue life of said structural member and prior to failure of said structural member due to fatigue when said ligament and said structural member are subjected to substantially similar stress conditions and history, and
- d. said groupings arranged such that said parallel ligaments in any said grouping will not be parallel to said parallel ligaments in any other said grouping in said test-coupon.

Claim 10 (original). The apparatus according to Claim 9 wherein said test coupon is composed of a material other than that composing said structural member.

Claim 11 (original). The apparatus according to Claim 9 wherein said cut-out portions are rectangular in shape having rounded corners described by ninety degree arcs joining any two adjacent sides such that said ligaments are all of equal length and width.

**CLAIMS (continued)**

Claim 12 (original). The apparatus according to Claim 11 wherein said test coupon is composed of a material other than that composing said structural member.

Claim 13 (original). The apparatus according to Claim 9 said cut-out portions define said ligaments to have a shape described by at least two adjoining rectangles of different surface area:

- a. positioned so that each successively smaller rectangular portion of said ligament is centered on the next larger adjoining rectangular portion of said ligament, and
- b. having rounded corners described by ninety degree arcs joining any two adjacent sides.

Claim 14 (original). The apparatus according to Claim 13 wherein said test coupon is composed of a material other than that composing said structural member.

Claim 15 (original). The apparatus according to Claim 9 wherein said test-coupon has at least two cut out portions of equal cross-sectional area and which define at least two ligaments of the same length and the same shape with different elastic moduli.

Claim 16 (original). The apparatus according to Claim 15 wherein said test coupon is composed of a material other than that composing said structural member.